



WILLIAM S.
Spears School
OF BUSINESS

Center for Applied Economic Research

Economic Impact of the Oklahoma Coal Industry

February 12, 2010

Prepared by:

Kyle Dean
Associate Director and Research Economist

Russell Evans
Director and Research Economist

I. Introduction

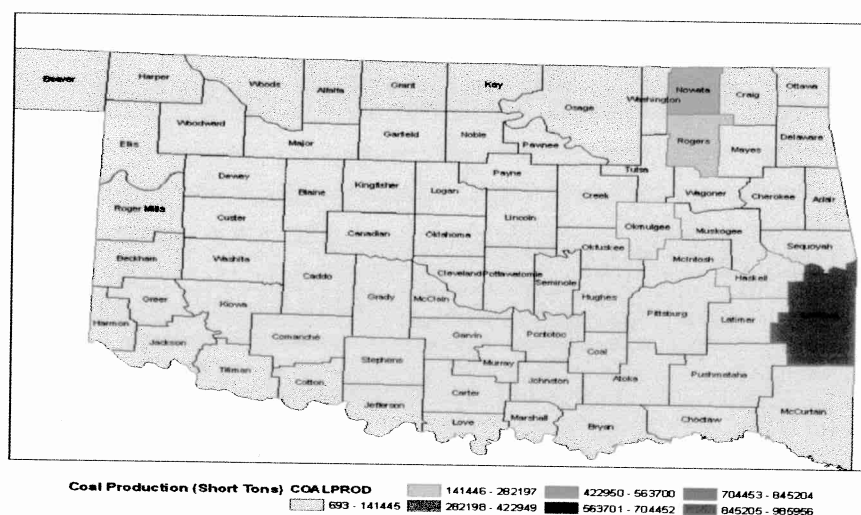
While the Oklahoma economy has indeed become more diverse, it remains heavily dependent on commodity and manufacturing production. Over the 1997 to 2008 period, agricultural production, mining, and manufacturing combine to account for roughly one-fourth of Oklahoma annual production. These sectors are of particular importance to Oklahoma's rural communities where much of the direct and indirect support activities occur.

The present report examines the role of Oklahoma's Coal producing sector on state economic activity. We begin by examining the structure, size, and geographical makeup of the industry. Following a brief background on the coal sector, we analyze the multiplier, or ripple, effects resulting from the Oklahoma operations of four producers, Phoenix Mining, Farrell-Cooper Mining, Georges Colliers Incorporated, and Brakefield Equipment. We then extend this data set to isolate the average Oklahoma expenditures associated with recovering one ton of Oklahoma coal and estimate the impacts associated with each ton mined. In essence, we pose the question: what are the economic impacts to the state of Oklahoma per ton of coal recovered?

II. Background

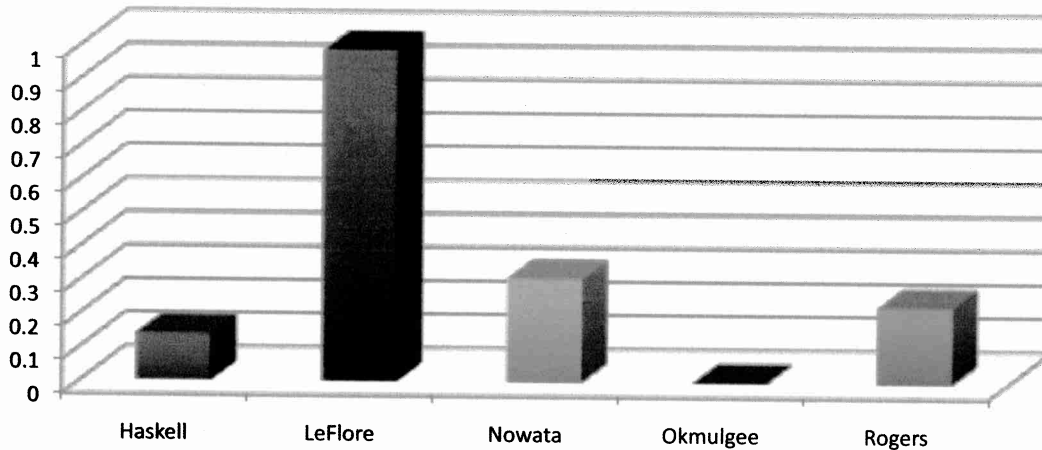
Oklahoma coal production is heavily isolated on the eastern side of the state within the Northeast Oklahoma shelf and Arkoma Basin. Much of the production is located in persistent poverty counties where the employment opportunities are of particular importance. Figure 1 below illustrates 2007 coal production by county, with the darker shaded counties representing greater levels of production.

Figure 1: Oklahoma Coal Production by County



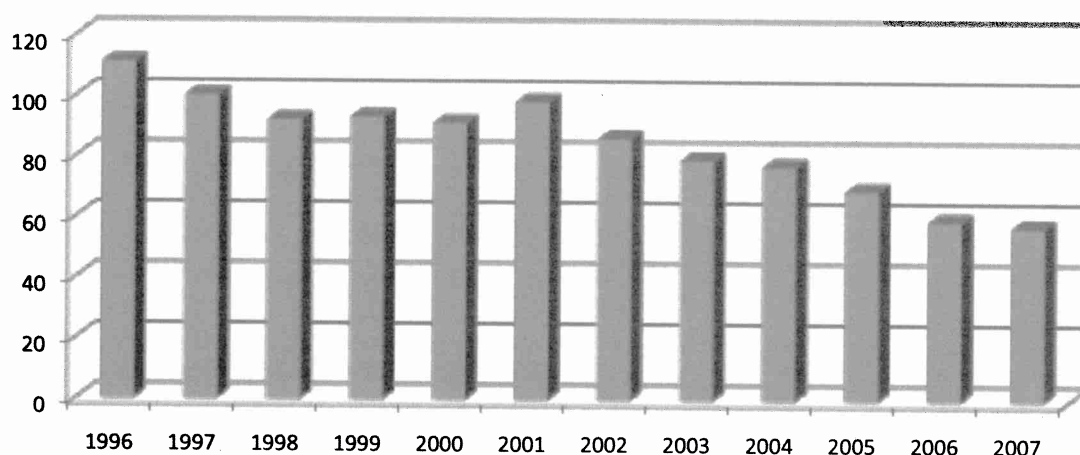
It is worth noting that while the active coalfields are confined to a handful of Oklahoma counties, the economic impacts may be felt more broadly as producers purchase supplies and support materials from vendors throughout the state. While much of the production occurs in LeFlore County, Haskell, Rogers, and Nowata counties all have active fields. Figure 2 reports short tons recovered by county.

Figure 2: 2007 Coal Production by County (Millions of Short Tons)



Oklahoma Coal production has varied considerably over the years with peak production of 5.7 million tons in 1981 and a low of 1.4 million tons in 2002. Over the last decade, however, production has been relatively constant in the 1.5 million to 2 million ton range. In 2007, the year of data used in this report, production came in at 1.6 million tons. Oklahoma coal production has steadied in recent years even as the quantity of new permits issued has waned, evidenced by Figure 3 below.

Figure 3: Annual Coal Mining Permits Issued



The majority of Oklahoma produced coal is now consumed in state by cement producers and utilities. The Oklahoma Department of Mines notes that, "There is potential for Oklahoma's coal resources to provide a basis for economic growth; only the apex of coal resources has been exploited. Large bituminous and metallurgical deposits remain to be produced, but will require large capital investments by sophisticated mining companies." Indeed, depending on the evolution of the coal market, coal-burning technologies, and U.S. energy policy, the Oklahoma coal industry could yet become an even more significant contributor to state economic activity. However, in order to facilitate this development the industry likely needs to maintain a base of Oklahoma coal consumers sufficient to generate capital flows required to fund the needed investment. Table 1 below summarizes essential industry characteristics for 2007.

Table 1: Key Coal Industry Characteristics for 2007

Producing Companies	11
Men Employed, Average Per Month	212
Man Days Worked	2,385
Total Man Hours Worked	449,736
Total Tonnage	1,660,518

Source: Oklahoma Department of Mines

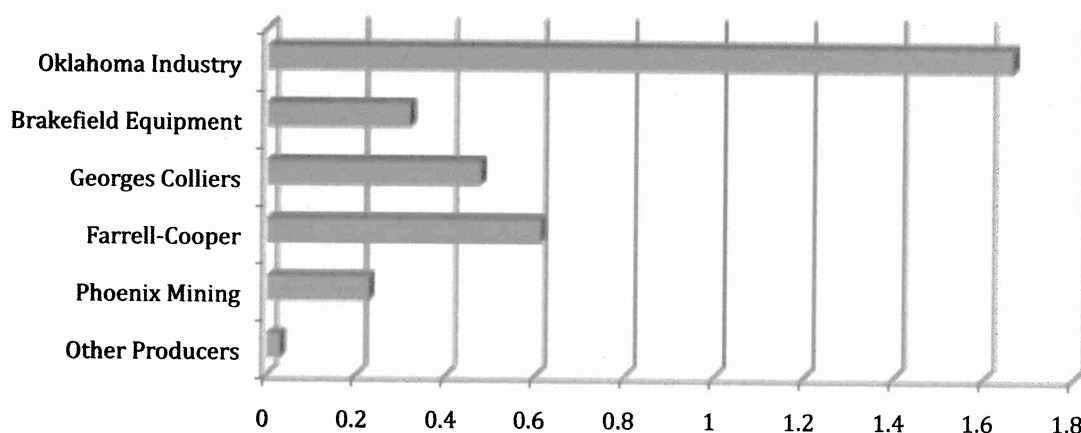
III. Study Parameters

Data from four Oklahoma producers was collected and analyzed for this report. In the context of the current report, the state of Oklahoma is defined as the regional economy. Of particular importance in economic impact assessments are expenditures occurring within the regional economy, specifically, all expenditures to Oklahoma vendors and all wages and salary distributed to Oklahoma workers. Combined with models of regional production and household consumption, aggregate impacts can be estimated from the original expenditures.¹

Four producers, Phoenix Coal, Farrell-Cooper, Georges Colliers Inc. (GCI), and Brakefield Equipment provided data on their 2007 operating expenditures. Payments made to Oklahoma workers and industries were isolated, with each vendor purchase categorized by the North American Industry Classification System (NAICS) category in which it occurred. By proceeding in this manner, we avoid the loss of information associated with estimating the expenditure pattern of local producers and the percent of the operating budget spent locally and are left with a more thorough examination of operational impacts.

Farrell-Cooper, Georges Colliers, Phoenix Mining and Brakefield Equipment are the state's four largest producers and combined to account for roughly 96% of the total statewide production for 2007 as indicated in Figure 4 below.

Figure 4: 2007 Coal Production (Millions of Short Tons)



¹ Original expenditures are commonly referred to as direct effects in impact studies and represent the initial expenditures of interest. The resulting adjustment of behavior by suppliers and households are known as indirect and induced effects respectively. All impacts reported in this text include direct, indirect, and induced effects. For a complete discussion of impact estimation methodology and an illustrative example, see appendix A.

The appropriate perspective for estimating the impacts of existing industry operations is to examine the counterfactual “what if this industry seized to exist?” Therefore, all impacts are derived as purchases and wage distributions are removed from the model and the resulting “negative” multiplier effects estimate the aggregate loss of economic activity. The following section summarizes the impacts associated with removing the four producers and their associated expenditures from the Oklahoma economy.

III. Study Results

The first look at the impact of the coal industry in Oklahoma comes from the exercise of removing all local expenditures from the economy and observing the resultant multiplier effects. In total, the four producers included in this assessment directly purchased just over \$45 million worth of Oklahoma produced goods and services in 2007. Removing these expenditures from the economy sets in motion a chain reaction as firms, now absent those purchases, adjust by reducing their own purchases of intermediate goods and services (indirect impacts). Likewise, supporting firms reduce their staff or payroll setting in motion reduced household expenditures by workers, further dampening economic activity (induced impacts).

Similarly, removing the contributions of these firms from the economy necessarily removes the income contributions they make through direct payroll. As wage and salaried workers from the coal industry remove from the economy household purchases of Oklahoma goods and services, a second round of economic contraction occurs.

Table 2 reports the economic activity lost as a result of removing all activity associated with the four producers from the economy on both a per firm and aggregate basis. The right-most column gives the total impact (direct, indirect, and induced) per firm, which are then summed together to get aggregate impacts for all firms included in the report. The reported values suggest that these four firms alone support over \$138 million in Oklahoma economic activity corresponding to 1,081 full-time equivalent jobs and \$38 million in Oklahoma income.²

² These totals are the sum of direct, indirect and induced (excluding payroll induced) impacts of the four producers.

Table 2: Summary Impacts from Producer Expenditures

Output	Direct	Indirect	Induced	Payroll Induced	Total
Phoenix Mining	\$12,407,153	\$1,449,920	\$1,701,336	\$576,936	\$16,135,345
Farrell Cooper	\$48,920,959	\$6,483,264	\$7,043,744	\$2,345,104	\$64,793,071
Georges Colliers	\$25,159,924	\$2,703,088	\$4,624,432	\$2,357,744	\$34,845,188
Brakefield Equipment	\$21,430,579	\$2,974,152	\$3,405,200	\$313,698	\$28,123,629
<i>Aggregate Output Impacts</i>	<i>\$107,918,615</i>	<i>\$13,610,424</i>	<i>\$16,774,712</i>	<i>\$5,593,482</i>	<i>\$143,897,233</i>
Income					
Phoenix Mining	\$2,728,431	\$492,799	\$516,655	\$446,535	\$4,184,420
Farrell Cooper	\$10,985,400	\$2,159,280	\$2,135,576	\$712,984	\$15,993,240
Georges Colliers	\$8,942,662	\$937,994	\$1,404,348	\$1,824,836	\$13,109,840
Brakefield Equipment	\$5,975,906	\$981,814	\$1,033,410	\$242,795	\$8,233,925
<i>Aggregate Income Impacts</i>	<i>\$28,632,400</i>	<i>\$4,571,887</i>	<i>\$5,089,989</i>	<i>\$3,227,150</i>	<i>\$41,521,426</i>
Employment (FTE)					
Phoenix Mining	60.29	11.92	15.81	5.36	93.38
Farrell Cooper	358.31	50.57	65.53	21.78	496.19
Georges Colliers	273.84	25.76	42.98	21.90	364.48
Brakefield Equipment	120.18	24.33	31.66	2.91	179.08
<i>Aggregate Employment Impacts</i>	<i>812.62</i>	<i>112.58</i>	<i>155.98</i>	<i>51.95</i>	<i>1,133.13</i>

State economic activity is likewise supported as employees of Oklahoma coal producers spend a portion of their income within the state. The impacts are the induced effects associated with Oklahoma coal generated income. Household expenditures on out-of-state goods and services, taxes paid, and many savings activities are treated as leakages with no Oklahoma impact. These additional effects are highlighted in the “Payroll Induced” column of Table 2.

The induced effects support an additional \$5.6 million in Oklahoma economic activity associated with 52 full-time equivalent jobs and \$3.2 million in Oklahoma income. Note that these are the employment effects associated with the economic activity induced by purchases made with coal generated income and do not reflect the direct employment by coal producers. Adding these Payroll Induced impacts yields the total impacts of the four producers in the final column of Table 2.

Finally, Table 3 provides the comprehensive impacts from both operational purchases of Oklahoma inputs as well as the induced effects of spent Oklahoma income by coal industry workers. Spending patterns of producers were analyzed to isolate the typical Oklahoma expenditures associated with active coal production and normalized to a per ton basis to estimate the impacts on a per ton standard. These results are likewise reported in Table 3.³

Table 3: Comprehensive Economic Impacts: Operational and Induced Effects

Output	\$143,897,233	Output per ton recovered	\$88.23
Income	\$41,521,426	Income per ton recovered	\$25.46
Employment	1,133.13	Employment per ton recovered	N/A

The output from Table 3 can be used to extend the impacts across all 1.66 million tons mined by all Oklahoma producers in 2007 to arrive at an estimate of statewide industry impacts. These results are presented in Table 4.

Table 4: Estimated Statewide Industry Impacts

Output	\$146,456,068
Income	\$42,259,775
Employment	1,153

III. Conclusion

The Oklahoma coal industry is a significant contributor to economic activity in an area of the state where it is much needed. Analyzing patterns of spending within Oklahoma revealed that coal industry purchases of Oklahoma goods and services, through the multiplier process, account for more than \$146 million in economic activity, generate \$42 million in Oklahoma income, and support 1,153 full-time equivalent jobs. While remarkable, these figures likely understate significantly the role of coal in the Oklahoma economy. The coal industry is uniquely local with relatively little of the resulting economic activity leaking beyond the state. Coal is recovered from Oklahoma lands using equipment, explosives, and labor originating in the state. The majority of the coal is then consumed by Oklahoma companies as an input to their individual production process, being transported to its point of consumption by Oklahoma truckers in vehicles maintained and serviced by Oklahoma mechanics before being burned in cement production facilities and utilities who

³ For the per ton estimates, only expenditures for Phoenix Coal and Farrell-Cooper Mining are included.

in turn deliver services to Oklahoma residents. Overall, a remarkably high percentage of the economic activity resulting from the commodity production, delivery, consumption, and output production remain in state.

Appendix A: Input-Output Models

Input-Output (I-O) models have a long history in regional science. The I-O framework was developed by Wassily Leontief in the late 1920s and early 1930s⁴. Isard (1960) contributed an early detailed discussion of regional and interregional I-O models. Other detailed discussions can be found in Miernyk (1965) and Bulmer-Thomas (1982). I-O models are used frequently for impact analysis because of their underlying structure that captures the interdependencies between industries and regions. As such, it will be used to estimate the dependency between areas within the study region.

I-O models use a fixed coefficient expenditure matrix to approximate dollar flows through a local economy. The expenditure matrix is estimated from economic flows at a given period in time. By effectively stopping the economy in time, I-O models allow the researcher to observe the magnitude of industry and institutional linkages within an economy. Specifically, I-O models begin with estimated dollar flows from industries to households and government sectors and vice versa. These frozen flows between industries and institutions (households, government, and foreign trade) provide a quantifiable measure of the inter-industry linkages in the economy. Finally, production is assumed to occur in fixed proportions, so that an increase in the final demand from any industry requires a proportional increase in the final demand of all supporting industries.

With the linkages modeled, prices assumed constant, and production assumed to occur in fixed proportions, impact analysis proceeds by tracing the initial effect of a change in the demand for a specific industry's output through the system of inter-industry relationships. For example, a new office park construction presents itself in the model as a change to the final demand for construction output. The "snapshot" of the economy reveals that increasing the output from the construction sector requires construction firms to increase their demand for materials and labor used in construction. Likewise, these support industries must increase purchases from their suppliers and hire additional workers to

⁴ Leontief published a seminal work in *The Review of Economics and Statistics* in 1936.

accommodate the original increase in demand. Thus the total impact to the economy is the direct increase in construction activity plus the indirect increase in supporting activities. Finally, note that workers in the construction and supporting industries have increased income as a result of the original project, and spend that income in accordance with personal consumption expenditure data. Thus the aggregate impact of the original project is the direct increase in construction activity plus the indirect increase in supporting activities plus the induced increase in consumption by households. For any project, I-O models measure the total impact as the sum of direct, indirect, and induced effects.

References

Bulmer-Thomas, Victor, 1982. *Input-Output Analysis in Developing Countries*. New York: John Wiley and Sons.

Isard, Walter, 1960. *Methods of Regional Analysis: An Introduction to Regional Science*. MIT Press (Cambridge) and John Wiley and Sons (New York).

Leontief, Wassily, 1936. "Quantitative Input-Output Relations in the Economic System of the United States." *The Review of Economics and Statistics*, 18(3), pp. 105 – 125.

Miernyk, William H., 1965. *The Elements of Input-Output Analysis*. Reprinted online in the "Web Book of Regional Science." Regional Research Institute, West Virginia University, www.rri.wvu.edu.